



DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2012-0260; Special Conditions No. 25-494-SC]

Special Conditions: Embraer S.A. Model EMB-550 Airplanes, Sudden Engine Stoppage

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the Embraer Model EMB-550 airplane.

This airplane has novel or unusual design features as compared to the state of technology envisioned in the airworthiness standards for transport-category airplanes. These design features include engine size and the potential torque loads imposed by sudden engine stoppage. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

EFFECTIVE DATE: [Insert date 30 days after Federal Register publication].

FOR FURTHER INFORMATION CONTACT: Cindy Ashforth, FAA, International Branch, ANM-116, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington 98057-3356; telephone (425) 227-2768; facsimile (425) 227-1320.

SUPPLEMENTARY INFORMATION:

Background

On May 14, 2009, Embraer applied for a type certificate for their new Model EMB-550 airplane. The Model EMB-550 airplane is the first of a new family of jets designed as a

corporate jet, and for fractional, charter, and private-owner operations. The airplane is a conventional configuration with a low wing and T-tail empennage. The primary structure is metal with composite empennage and control surfaces. The Model EMB-550 airplane is designed for eight passengers, with a maximum of 12 passengers (including toilet seat). It is equipped with two Honeywell HTF7500-E medium-bypass-ratio turbofan jet engines mounted on aft-fuselage pylons. Each engine produces approximately 6,540 lb of thrust for normal takeoff. The primary flight-control systems are electronically controlled using fly-by-wire (FBW) technology.

The Model EMB-550 airplane incorporates novel or unusual design features involving engine size and torque load that affect the airframe as it relates to sudden engine-stoppage conditions.

Type Certification Basis

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.17, Embraer must show that the Model EMB-550 airplane meets the applicable provisions of part 25, as amended by Amendments 25-1 through 1-127.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Model EMB-550 airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates

the same novel or unusual design feature, the special conditions would also apply to the other model.

In addition to the applicable airworthiness regulations and special conditions, the Model EMB-550 airplane must comply with the fuel-vent and exhaust-emission requirements of 14 CFR part 34 and the noise-certification requirements of 14 CFR part 36; and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the “Noise Control Act of 1972.”

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

Novel or Unusual Design Features

The Model EMB-550 airplane incorporates a novel or unusual design:

The Embraer Model EMB-550 airplane will incorporate a medium-bypass-ratio turbofan jet engine that will neither seize nor produce transient torque loads in the same manner that is envisioned by current § 25.361(b)(1) regarding “load that affect sudden engine stoppage” conditions.

Discussion of Comments

Notice of Proposed Special Conditions No. 25-12-05-SC, for the Embraer Model EMB-550 airplane, was published in the Federal Register on September 25, 2012 (77 FR 58970). No comments were received, and the special conditions are adopted as proposed.

Discussion

The size, configuration, and failure modes of jet engines have changed considerably from those envisioned by 14 CFR 25.361(b), when the engine-seizure requirement was first adopted.

Engines have become larger and are now designed with large bypass fans capable of producing much larger and more complex dynamic loads. Relative to the engine configurations that existed when the rule was developed in 1957, the present generation of engines is sufficiently different and novel to justify issuance of a special condition to establish appropriate design standards for the Embraer Model EMB-550 airplane type design.

Consideration of the limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming) has been a specific requirement for transport-category airplanes since 1957. In the past, the design torque loads associated with typical failure scenarios have been estimated by the engine manufacturer and were provided to the airframe manufacturer as limit loads. These limit loads were considered simple and pure torque static loads.

It is evident from service history that the engine-failure events that tend to cause the most severe loads are fan-blade failures, which occur much less frequently than the typical “limit” load condition.

The regulatory authorities and industry have developed a standardized requirement in the Aviation Rulemaking Advisory Committee (ARAC) forum. The technical aspects of this requirement have been agreed upon and have been accepted by the ARAC Loads and Dynamics Harmonization Working Group, and incorporated in EASA CS-25. The proposed special conditions outlined below reflect the ARAC recommendation and CS-25. In addition, the ARAC recommendation includes corresponding advisory material that is considered an acceptable means of compliance to the proposed special conditions outlined below.

To maintain the level of safety envisioned in § 25.361(b), more comprehensive criteria are needed for the new generation of high-bypass engines. The special conditions would distinguish between the more common engine-failure events and those rare events resulting from structural failures. The more-common events would continue to be treated as static torque limit load conditions. The more-severe events resulting from extreme engine-failure conditions (such as loss of a full fan blade at redline speed), would be treated as full dynamic-load conditions. These would be considered ultimate loads, and include all transient loads associated with the event. An additional safety factor would be applied to the more-critical airframe supporting structure.

Applicability

As discussed above, these special conditions are applicable to the Model EMB-550 airplane. Should Embraer apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

Conclusion

This action affects only certain novel or unusual design features on one model of airplane. It is not a rule of general applicability.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

The Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for the Embraer Model EMB-550 airplane.

In lieu of 14 CFR 25.361(b), the following special conditions apply:

1. For turbine-engine installations, the engine mounts, pylons, and adjacent supporting airframe structure must be designed to withstand 1g level flight loads acting simultaneously with the maximum limit torque loads imposed by each of the following:
 - (a) Sudden engine deceleration due to a malfunction, which could result in a temporary loss of power or thrust, and
 - (b) The maximum acceleration of the engine.
2. For auxiliary power unit (APU) installations, the APU mounts and adjacent supporting airframe structure must be designed to withstand 1g level flight loads acting simultaneously with the maximum limit torque loads imposed by each of the following:
 - (a) Sudden APU deceleration due to malfunction or structural failure; and
 - (b) The maximum acceleration of the APU.
3. For engine-supporting structure, an ultimate loading condition must be considered that combines 1g flight loads with the transient dynamic loads resulting from:
 - (a) The loss of any fan, compressor, or turbine blade; and separately
 - (b) Where applicable to a specific engine design, any other engine structural failure that results in higher loads.
4. The ultimate loads developed from the conditions specified in paragraphs 3(a) and 3(b) of these special conditions are to be multiplied by a factor of 1.0 when applied to engine

mounts and pylons, and multiplied by a factor of 1.25 when applied to adjacent supporting airframe structure.

5. Any permanent deformation that results from the conditions specified in paragraph 3 of these special conditions must not prevent continued safe flight and landing.

Issued in Renton, Washington, on June 21, 2013.

Jeffrey E. Duven
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service

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